

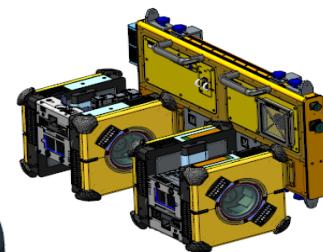
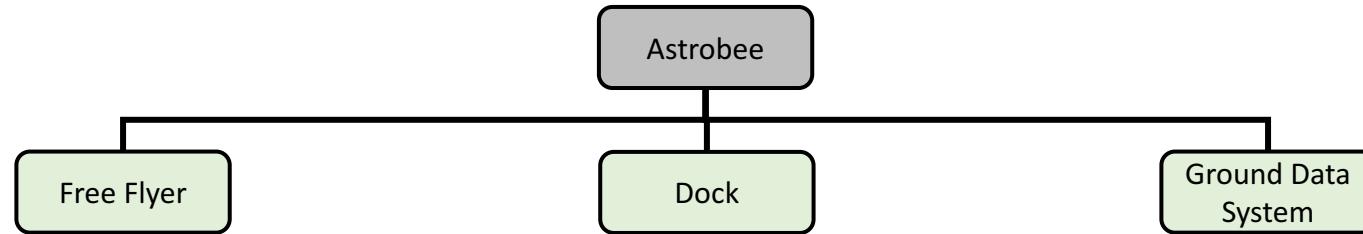
# Astrobee System Overview



POIWG #41 Astrobee Splinter  
April 25, 2017

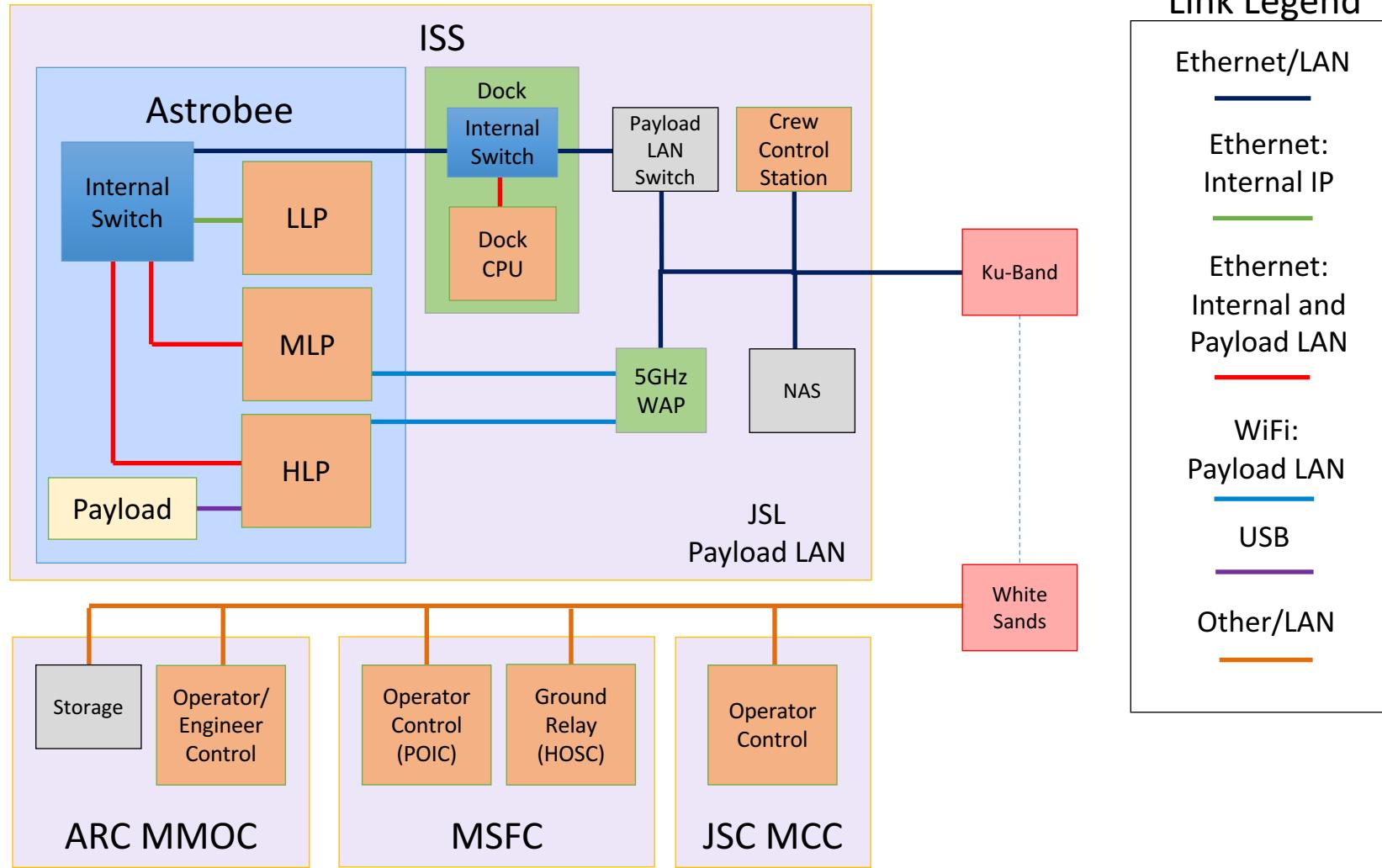


# Astrobee Elements



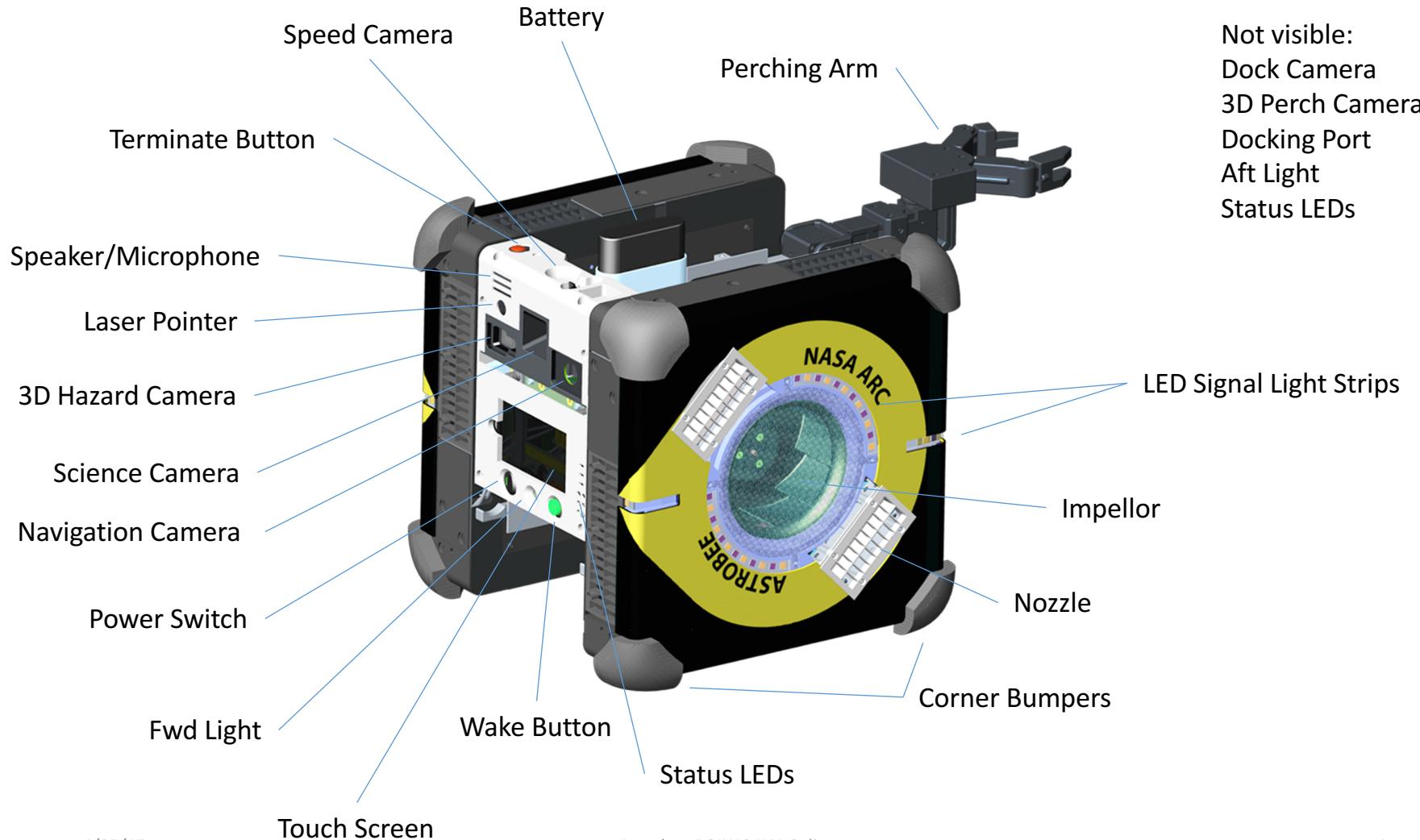


# System Data Flow Diagram





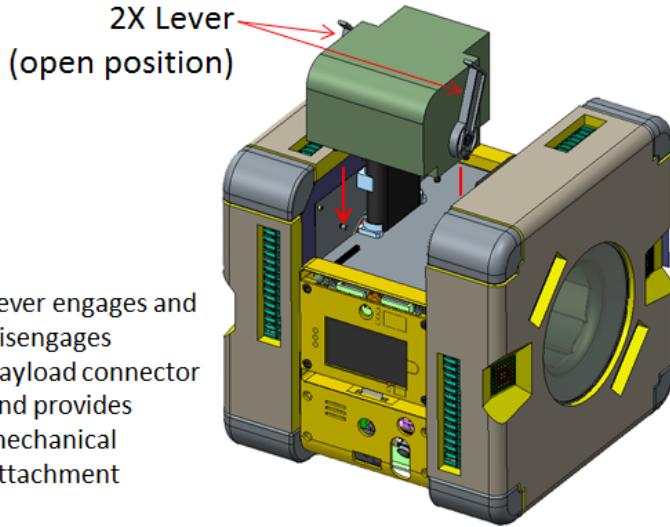
# Astrobee





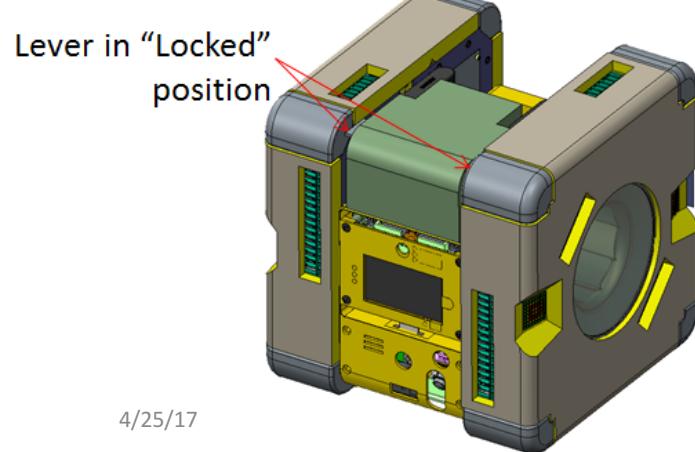
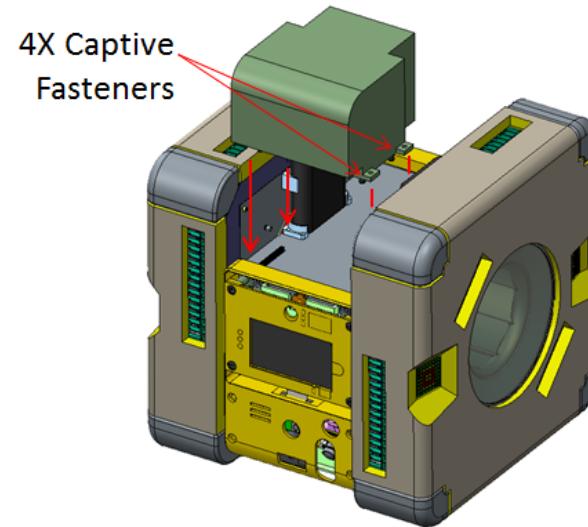
# Payload Attachment Options

## Quick "No Tool" Payload Attachment

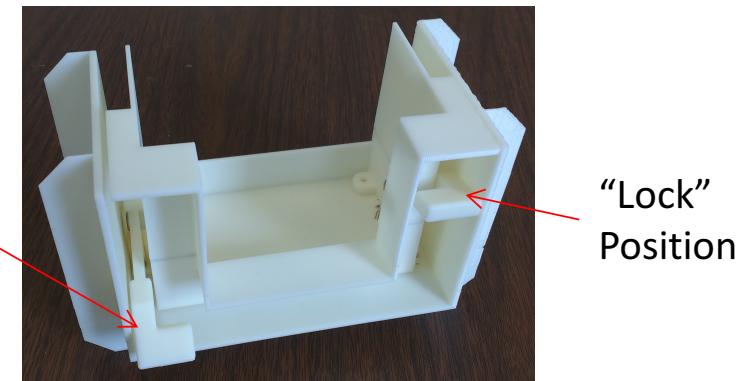


Lever engages and disengages payload connector and provides mechanical attachment

## 4X Fastener Payload Attachment



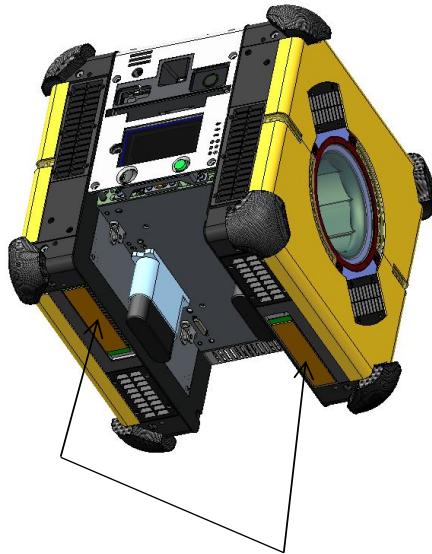
"Un-Lock" Position



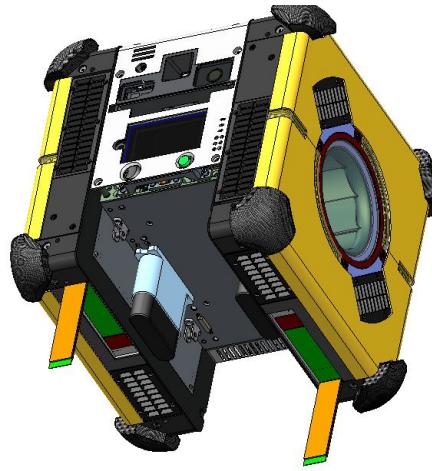


# Restraint Straps

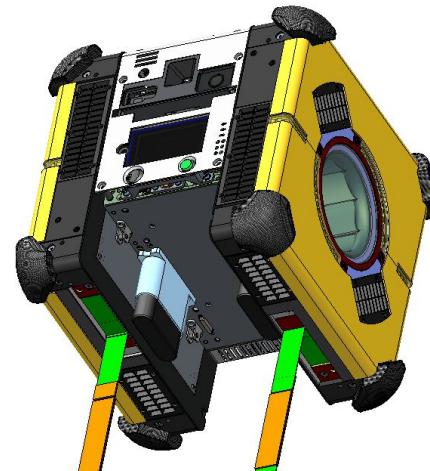
Strap with Velcro hook allows Astrobee to be restrained to ISS loop patches



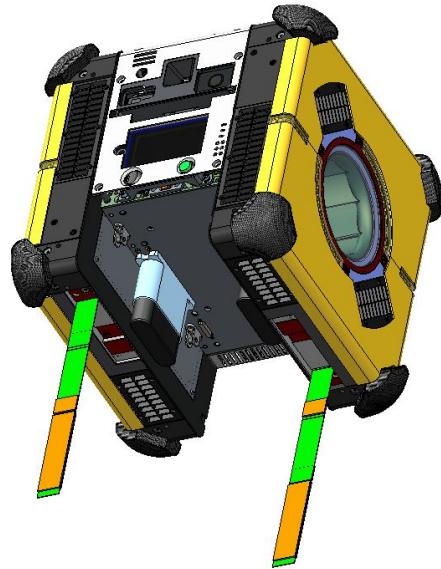
Two deployable straps  
for restraining Astrobee on  
station. Velcro Hook on ends of  
straps



Strap is unfolded  
1 fold



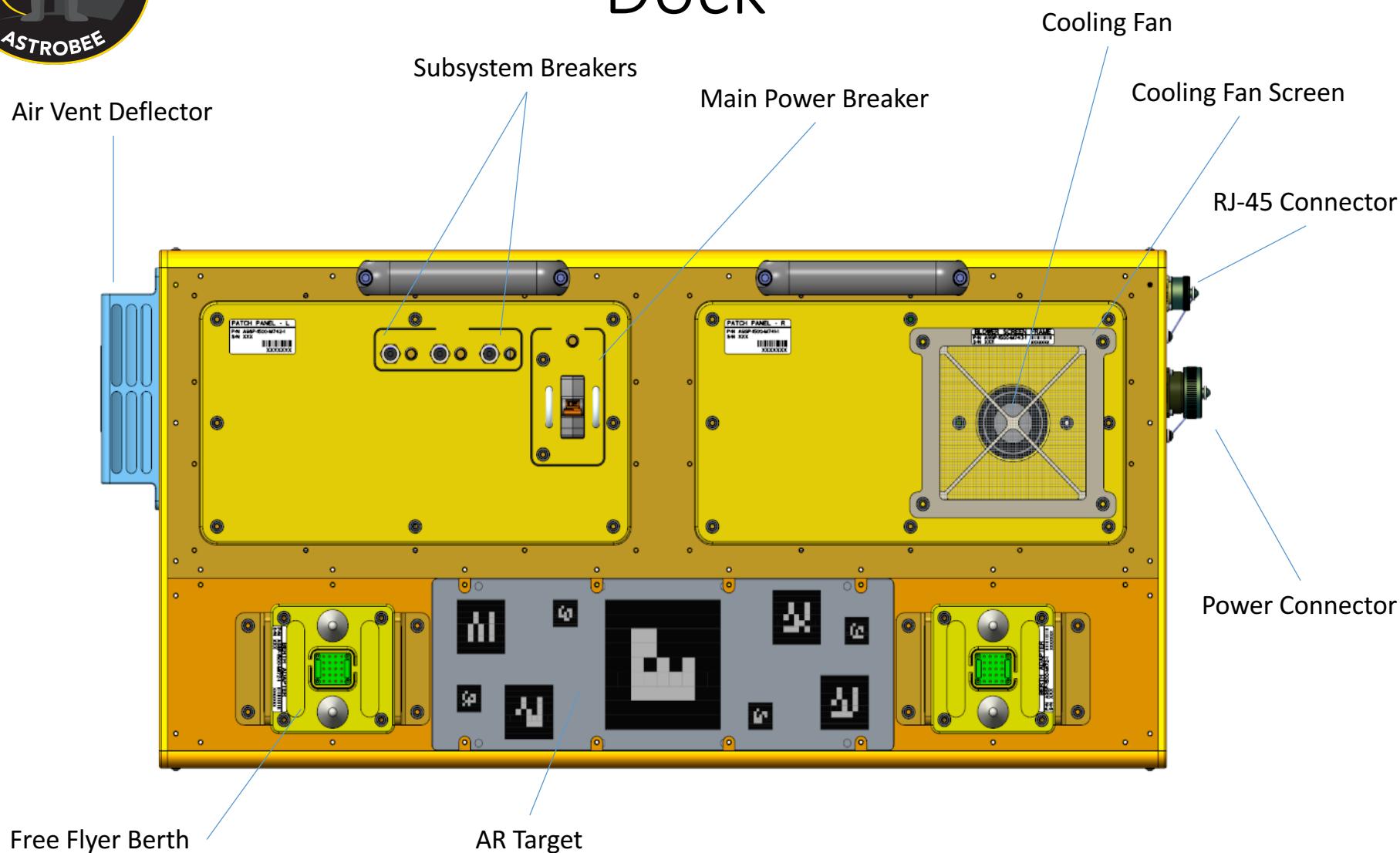
Strap is unfolded  
2 folds



Fully Deployed  
~ 10" Strap



# Dock





## Run Plan Tab

The screenshot shows the FreeFlyer software interface with several key components and annotations:

- Top Bar:** File, Edit, View, Help, Run Plan, Teleoperation, Guest Science.
- Header:** FreeFlyerA, Comm (green), Control, DW@DW-Windows7-32, Batt 84, Docking Station (yellow), GPS 11Jan17 18:20:23.
- Health and Status:** Operating State: Plan Execution, Mobility State: Flying, Operating Limits: Default\_Safeguard, Plan: ExamplePlan, Plan Status: Executing.
- Robot Commanding:** Initialization (Wake), Robot Commanding (File ..., Plan Valid, Load, Run, Pause, Skip Step), Description: A plan that goes in a spiral.
- Plan:** Total Elapsed Time: 00:00:43. A table showing Plan Step, Duration, and Success for the ExamplePlan and 2-3 Segment. The 2-3 Segment row is highlighted with a green bar.
- Live Telemetry, Live Images, Science Camera:** Tabs for monitoring the mission.
- 3D Model:** A 3D rendering of the Astrobee POIWG #41 Splinter structure. A red cloud annotation points to the model with the text "Model of loaded plan".
- Control Panel:** Includes a 2D coordinate system, zoom (+/-), reset view, and center on Bee buttons.
- Bottom:** Text "Astrobee POIWG #41 Splinter" and the date "4/25/17".

Red cloud annotations provide instructions:

- Select and upload Plan, and control Plan execution (top right).
- Monitor plan execution (bottom left).
- Model of loaded plan (3D model area).



# Teleoperation Tab

File Edit View Help

Run Plan Teleoperation Guest Science

FreeFlyerA Comm Control DW@DW-Windows7-32 Batt 87 Docking Station GPS 12Jan17 01:46:27

Health and Status

Operating State	Ready
Mobility State	Stopped
Operating Limits	Default_Safeguard
Plan	
Plan Status	Idle

Manual Commanding Perching Arm Docking

Initialization Manual Inputs Options Commands

Wake Aft 0.5 Fwd Roll -0.0 deg Allow Lateral Motion Move

Grab Control Port -0.5 Stbd Pitch -0.0 Stop

No Bookmark Selected Ovhd 0.0 Deck Yaw -45.0 Override Keepouts

Construct and send movement commands

Configurable Teleop Commands

Gripper Open

Idle Propulsion Idle

Payload A On

Flashlight Brightness

Front High Set

Data Type Action

Immediate Download Send

Live Telemetry Live Images Live Video

Astrobee POIWG #41 Splinter

LAB1S1 LAB1S2 LAB1S3 LAB1S4 LAB1S5

LAB1D1 LAB1D2 LAB1D3 LAB1D4 LAB1D5

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# Guest Science Tab

**Crew Control Station**

File Edit View Help

Run Plan Teleoperation Guest Sci

Docking Station GPS 17Jan17 18:44:47

Astrobee Selection and Status

	Control	Batt	Summary	Plan	Plan Status	Health
<input type="checkbox"/> FreeFlyerA	nobody	85			Idle	
<input checked="" type="checkbox"/> FreeFlyerB	DW@DW-Windows7-32	85			Idle	
<input type="checkbox"/> FreeFlyerC						

Checkboxes select Astrobees to command

Status summaries

Names of loaded Plans

Commanding for FreeFlyerB

Wake Grab Control

Plans

Load Run Stop

Manual Commanding

Guest Science Command

Send Command

4/25/17

18:41:36 FreeFlyerB: Grab Control

Live Telemetry Live Images Science Camera

Monitor Astrobee positions in 3D window

Astrobee POIWG #41 Splinter

x y z

10



# ISS Commissioning Activities

- Planned Activities:

- Installation
- Comm Checks
- Component Checkouts
- Initial Mapping
- Basic Mobility
- Autonomous Mobility
- Crew Interface Checkout
- Incremental Mapping – no crew needed
- Astrobee “B” and “C” Commissioning
- Demonstration – no crew needed other than payload installation in advance of demo



# Initial Mapping Activity

- Example of an activity explicitly involving crew

Component Activities/Tests	Description
Setup	Astrobee engineering prepares free flyer for activity (wakes, initializes system, etc.)
AR Localization Test	Crew physically “flies” the robot around in the vicinity of the dock to test AR target localization
Crew mapping	Crew physically “flies” the robot around in the module containing the dock to collect initial map data
Shutdown	Astrobee engineering downlinks files and shuts down the free flyer



# Autonomous Mobility Activity

- Example of an activity that does not explicitly involving crew for the entire duration

Component Activities/Tests	Description
Setup	Astrobee engineering prepares free flyer for activity (wakes, initializes system, etc.)
Demonstrate autonomous undock/dock	Crew manually places robot in 4 initial positions for docking tests
Demonstrate complex trajectory	Astrobee engineering commands the free flyer to fly one simple, one moderate, and one challenging trajectory
Demonstrate autonomous perching	Astrobee engineering commands the free flyer to fly to a perch location and perch
Demonstrate pan/tilt	Astrobee engineering commands the free flyer to pan and tilt while perched
Shutdown	Astrobee engineering returns the free flyer to the dock, downlinks files and shuts down the free flyer